



Do Engineering:

Teaching Platforms for Circuits Courses



Things doing and to be done.

Cotton Picker

New Standard Phonograph

Hand turning phonograph.

New Slow Speed cheap Dynamo.

New Expansion Pyromagnetic Dynamo.

Deaf Apparatus

Electrical Piano

Long distance standard Telephone transmitter
which employs devices of recording phonograph

Telephone Coil of Fe by H in Paraffine or other insulator
Platina Point Trans using new phono Recorder devices.

Grid Battery for Telephone

" " " Long Distance
" " " Phonoplex
" " " Jump telegraph
" " " Volt motor.

Improved Magnetic Bridge for practical work

Motograph Mirror

" Relay

" Telephone practical.

Artificial Cable.

Phono motor to work on 100 Volt ckt.

Duplicating Phono Cylinders

Deposit in Vacuo on Lacc gold & silver
also on Cotton Motten Chemical compound of lustrous
surface to imitate silk - also req plating system

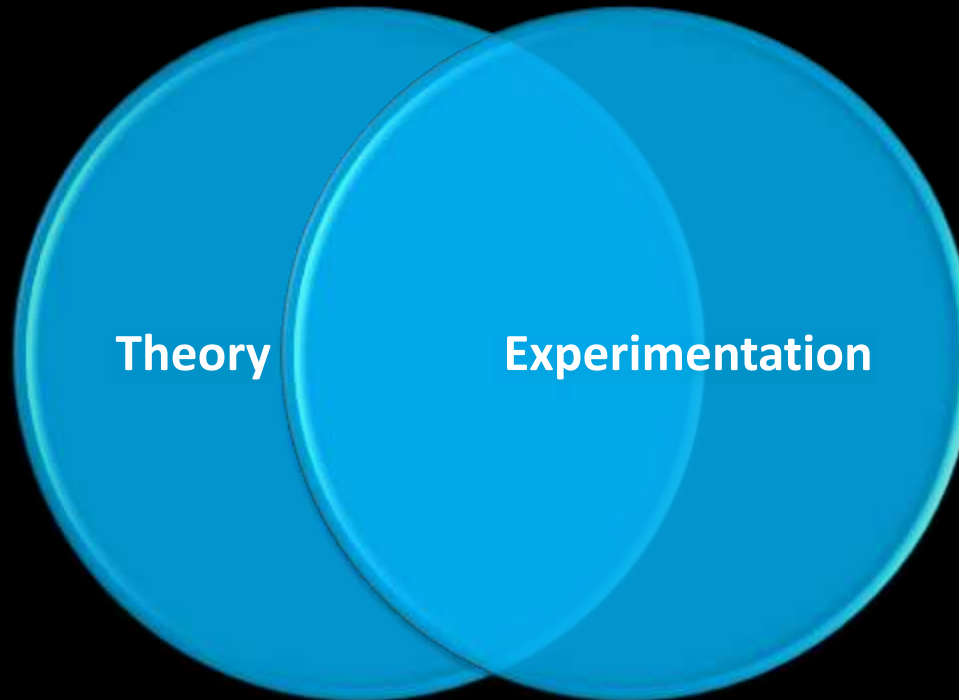
Vacuous Ore Milling Large Machine.

Magnetite Separator Large "

Locking material for Iron sand.



The Era of Experimentation



Engineering Grand Challenges



Advance health informatics



Engineer the tools of scientific discovery



Reverse-engineer the brain



Provide energy from fusion



Engineer better medicines



Provide access to clean water



Enhance virtual reality



Restore and improve urban infrastructure



Develop carbon sequestration methods



Advance personalized learning



Make solar energy economical



Prevent nuclear terror



Secure cyberspace



Manage the nitrogen cycle

Do ENGINEERING

To Do:

Haptics for tumor detection
3D Display System
Rotary UAV autopilot
Perfect Tuner
Pitch Pressure analysis and
logging system



WIN EcoCAR!



The GRAND Challenges

Advance health informatics

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Brain



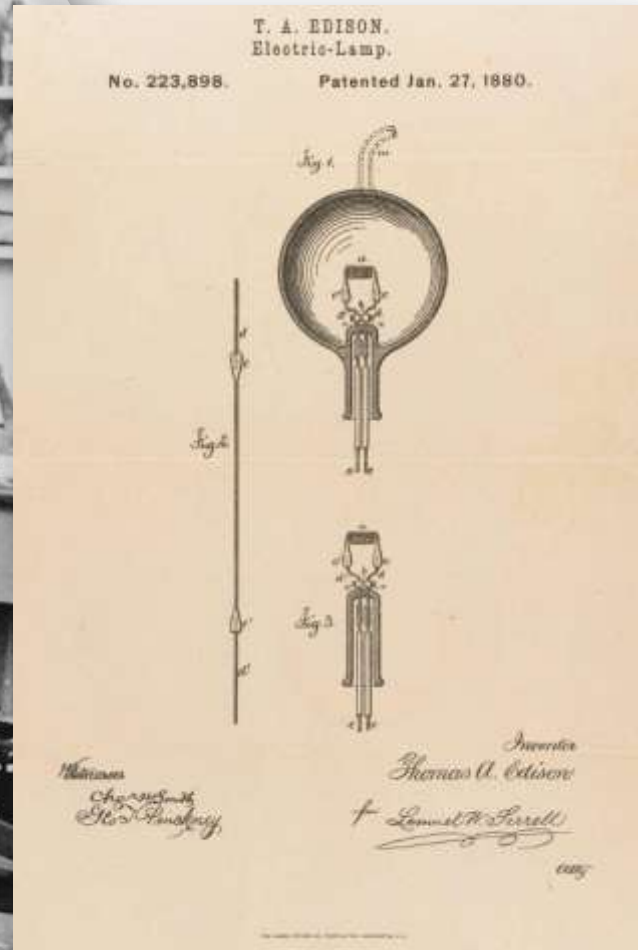
Obstacles to Duplicating Edison's Lab:

\$ Cost

⌚ Accessibility & Time

□ Ratio

We need a “return to Edison”



Challenge Faced by Engineering Educators

Educators are Pressured to

- Increase student enrollment
- Create more engaging hands-on experiences
- Prepare students for an increasingly complex world
- Make students more successful in the lab (minimize drop-out and maximize output)

Constrained by

- Reduced budget
- Fewer credit hours
- With full research load

Circuits Teaching Solution

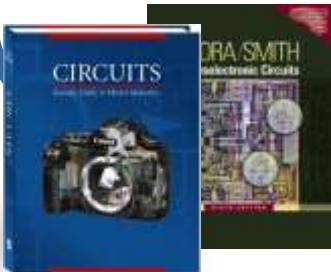
Analog, Digital and Power



National Instruments Circuits Solution

- Scalable teaching software and hardware platform:
 - Combined with curriculum and textbooks
 - Developed to enable improved student comprehension
 - Facilitates a “Do Engineering” focus in academia

Textbooks,
Curriculum,
& Courseware



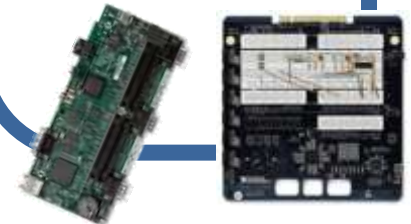
Teaching
Software



Teaching
Laboratory
Hardware

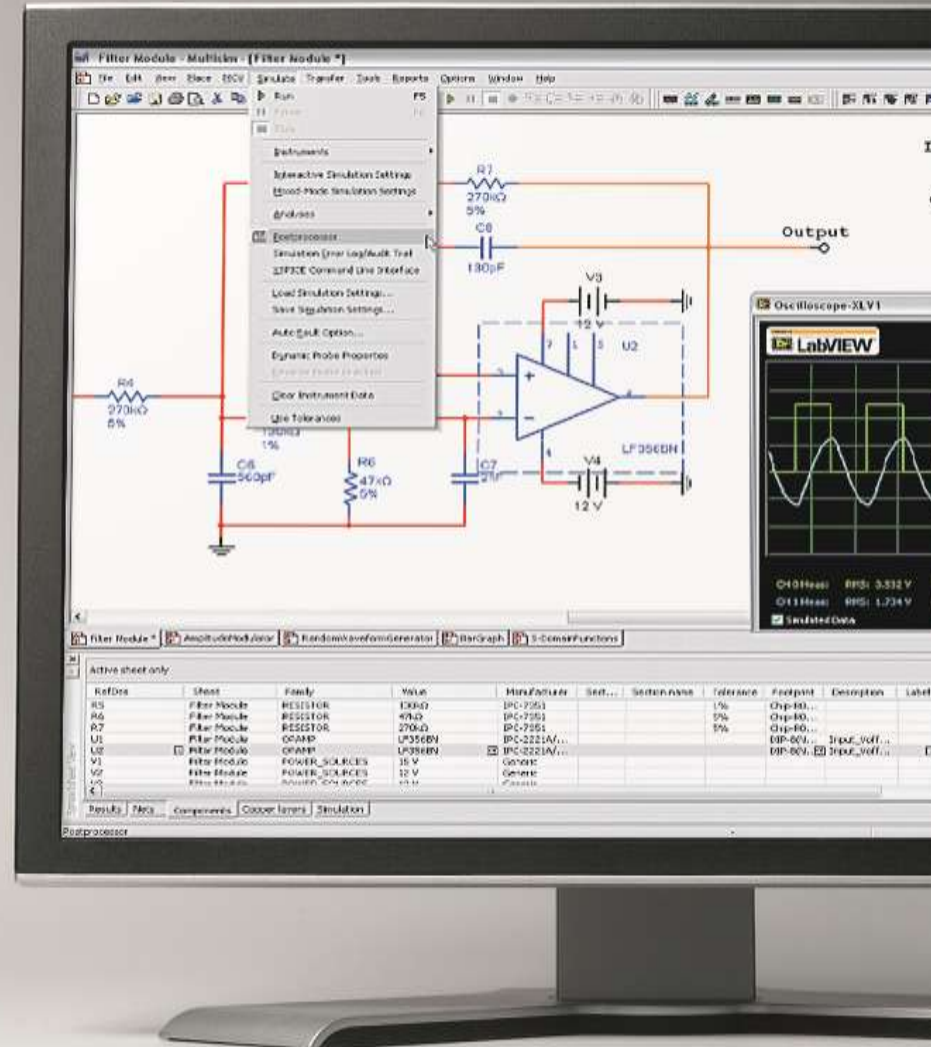


Curriculum
Partners



NI Multisim Circuits Teaching Environment

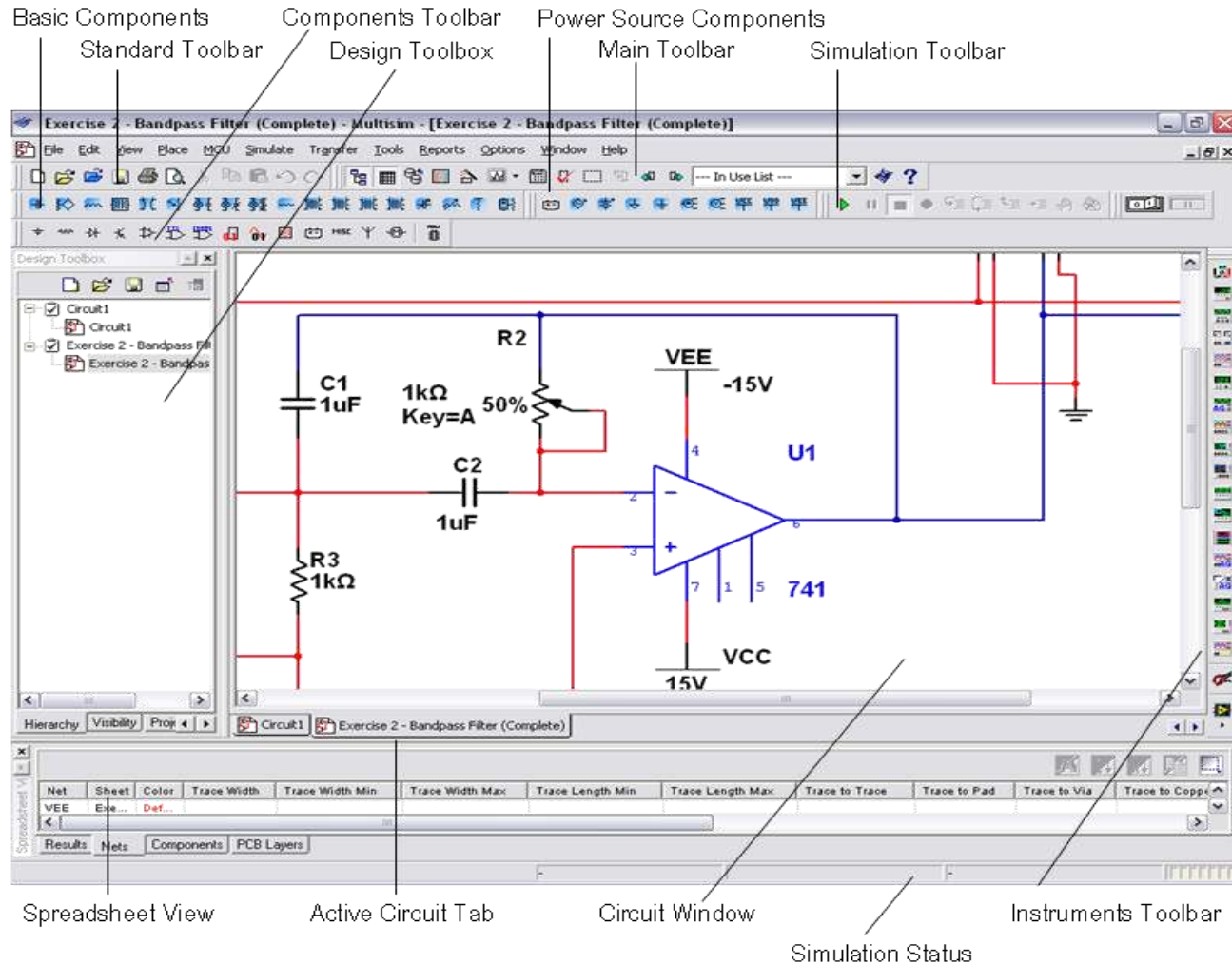
- Interactive circuit teaching solution to engage students
 - Interactive components
 - Intuitive instruments
 - Rated components
- Circuit behavior visualization
 - Easy-to-use analyses
 - Rapidly adjustable measurements instruments
 - Correlation of theoretical and real measurements



NI Multisim Circuits Teaching Environment

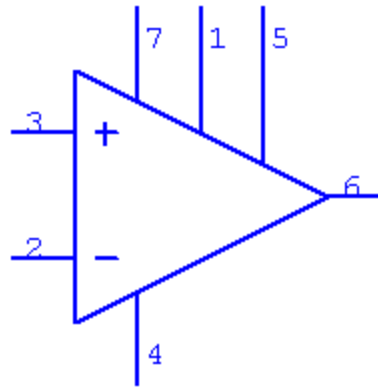
- Intuitive circuit drawing (schematic) environment
 - Optimized for students to quickly focus on theory
 - Rapidly define and simulate circuits in homework and lab-prep
 - Change component values to learn how circuit behavior changes
- Simulations driven by industry standard SPICE
 - Accurate simulations based upon SPICE/XSPICE parsers
 - Measurement instruments to quickly visualize behavior
 - SPICE analyses to translate “equations” into “understanding”
- Integration between circuit image and real lab hardware

NI Multisim Circuits Teaching Environment

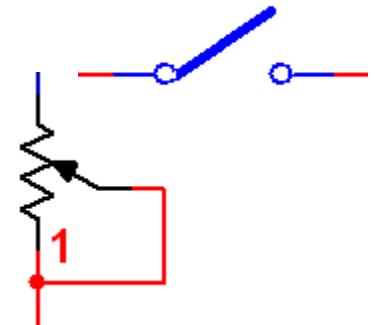


Multisim Component Symbols

- Multisim contains thousands of components
 - Analog, Digital, RF, Microcontroller, Virtual Components
 - Interactive components can change value during simulation
- SPICE models incorporated from leading manufacturers:
 - Analog Devices
 - Texas Instruments
 - On Semiconductor
 - Infineon
 - NXP
 - Microchip
 - Etc....



Analog Components



Interactive Components

NI Multisim Simulation

- Use simulation to teach/learn without being a SPICE expert
- Multisim facilitates education by interacting with SPICE, two ways

Method 1 – Interactive SPICE Simulation

MCU Simulation Options

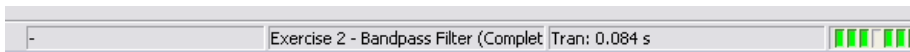
Stop Simulation

Pause Simulation

Start Simulation

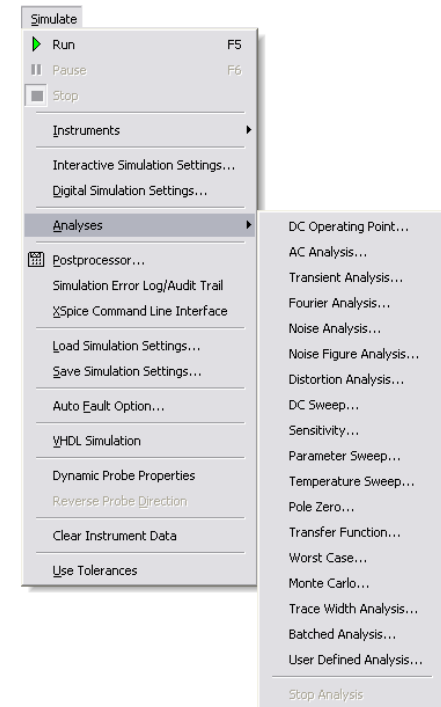


Simulation Toolbar



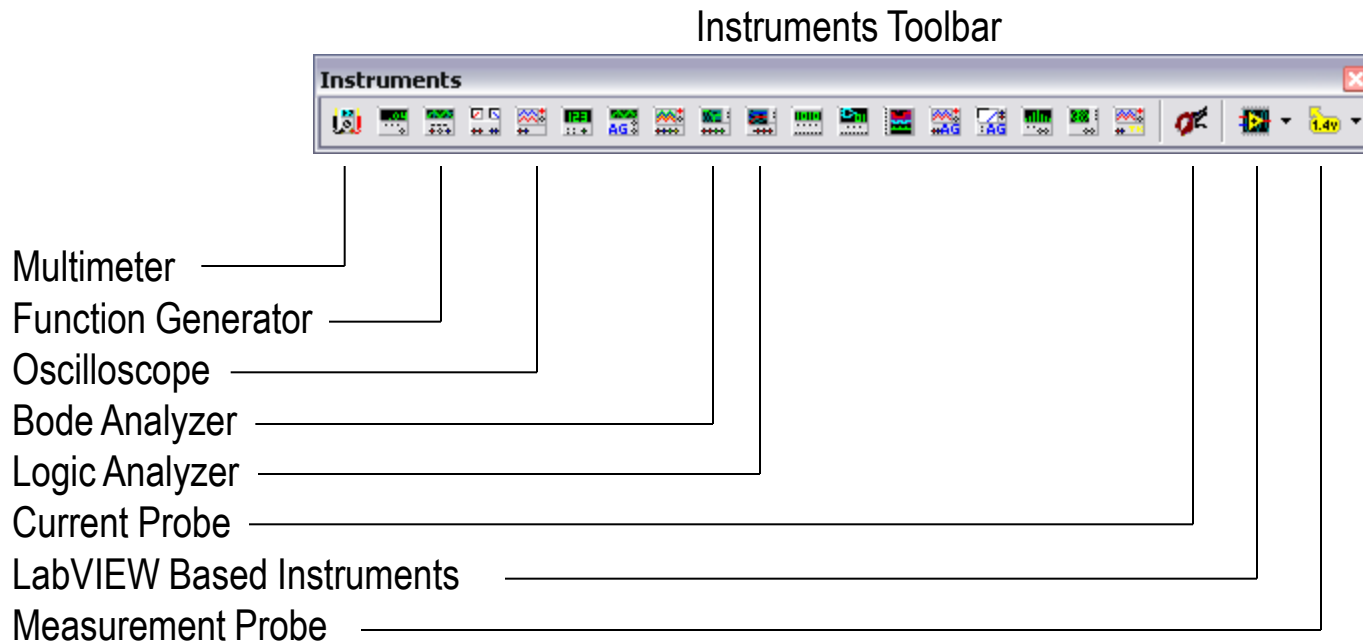
Interactive Simulation Status

Method 2 – SPICE Analyses

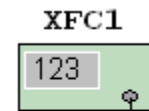


Multisim Interactive Measurement Instruments

- 24+ instruments to rapidly measure and visualize results
- Connect instruments to circuits as done with real equipment
- Double-click to interact with instruments exactly as in lab



Frequency Counter



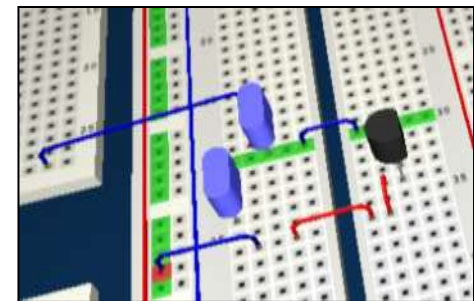
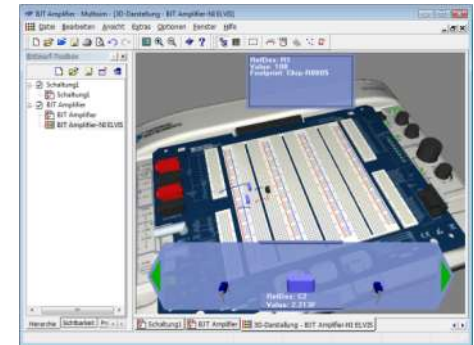
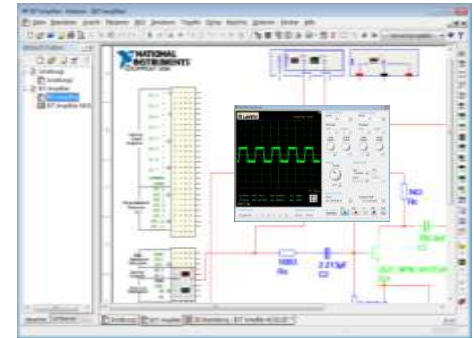
Schematic Symbol



Front Panel

Multisim Teaching Environment

- NI Multisim
 - SPICE-based simulation
 - Analog, digital, mixed
 - Interactive parts
 - Virtual instruments
 - Circuit faults and restrictions
- Integration with NI ELVIS II/II+
 - 3D virtual breadboard
 - NI ELVIS instruments
 - Input/output of real-world signals



NI ELVIS Measurement & Instrumentation Platform

Circuits Teaching Hardware

- Teaching platform developed for circuits education
- Includes 12 fundamental instruments used in laboratory
 - Replaces traditional, singular use benchtop instruments
- Integrated prototyping breadboard enables:
 - Students to quickly build circuits
 - Connect to measurement/analysis
- Seamless integration to Multisim to compare and correlate real and simulated
 - View, print or include measurements in lab reports



NI ELVIS

Internal Circuit Protection

- Resettable fuses

USB Connectivity

- Plug-and-play capability
- USB 2.0 Connection

Function Generator

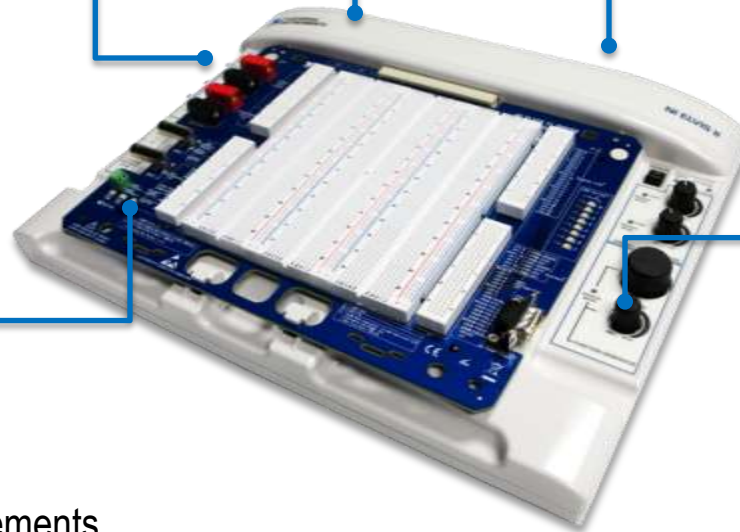
- 10 bit, $\pm 5V$ range
- 0.2 Hz to 5 MHz Sine
- 0.2 Hz to 1 MHz Triangle/Square
- Software or manual control
- BNC or prototyping board connection

Oscilloscope

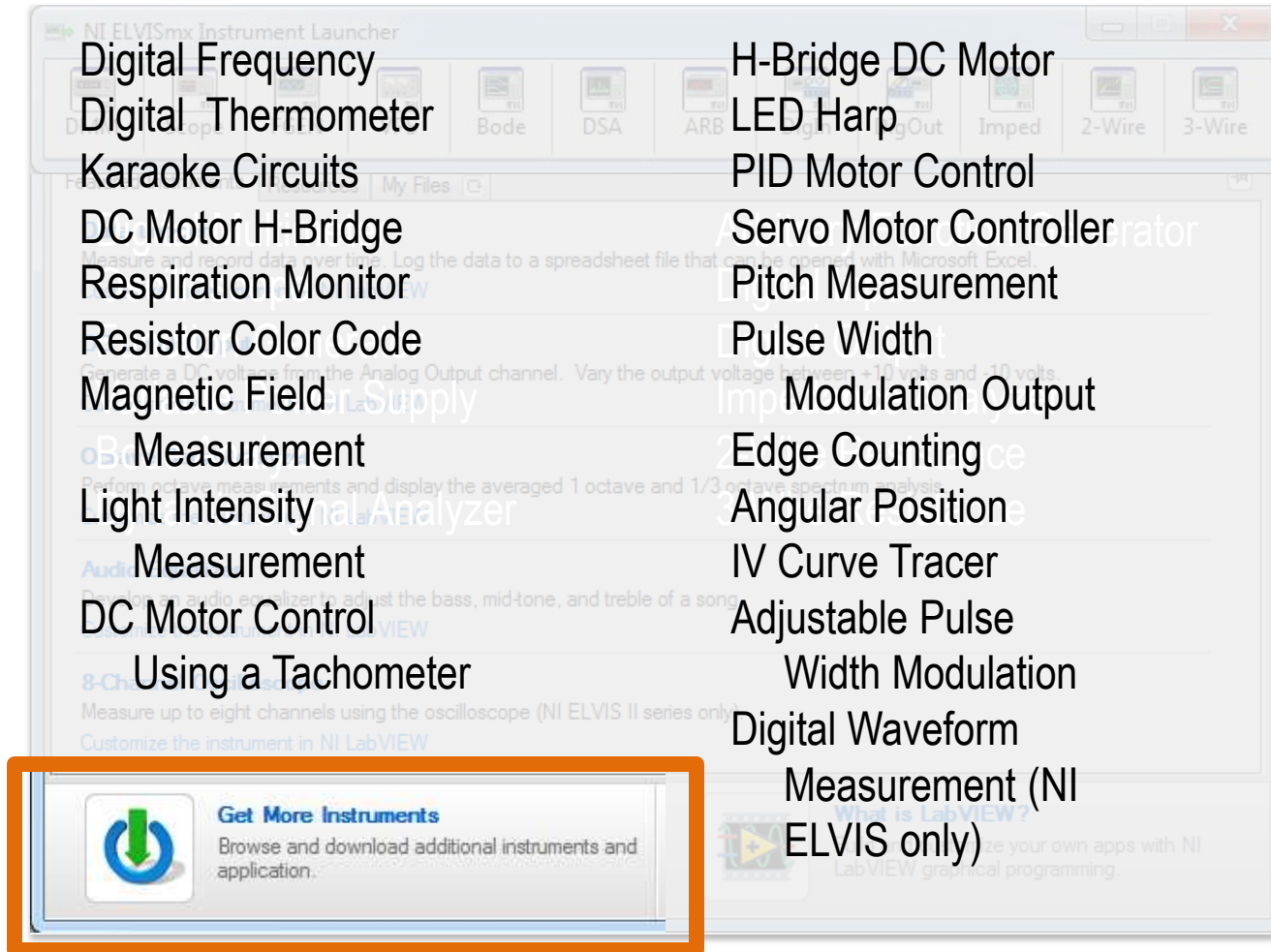
- ELVIS II+: 100MS/s Sampling Rate
- ELVIS II: 1.25 MS/s single channel, 500kS/s two channel aggregate
- 16-bit resolution
- 1 to 1.5 MHz Bandwidth
- 1x and 10x probe
- $\pm 10 V$ input range
- AC/DC coupling

Digital Multimeter

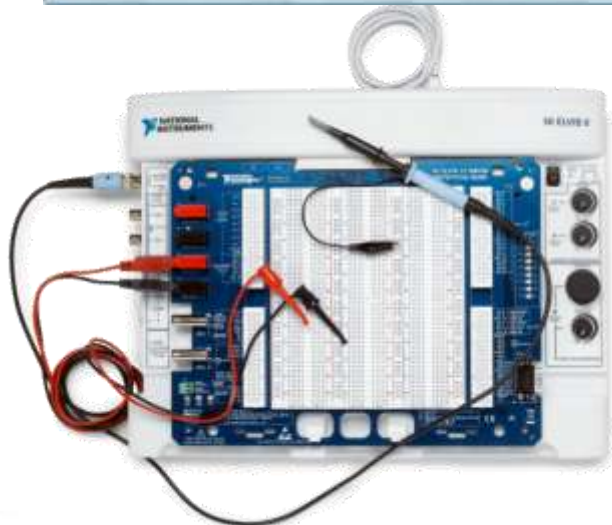
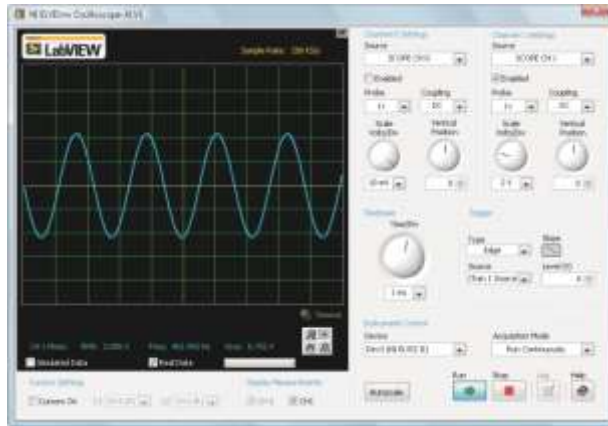
- Isolated measurements
- $5\frac{1}{2}$ digit resolution
- 60 VDC, 20Vrms, 2 ADC, 2 RMs, 100M Ω



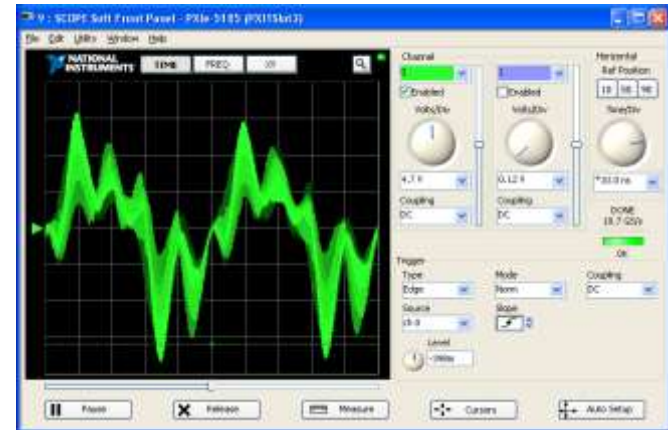
Virtual Instruments



Begin Taking Measurements Soft Front Panels



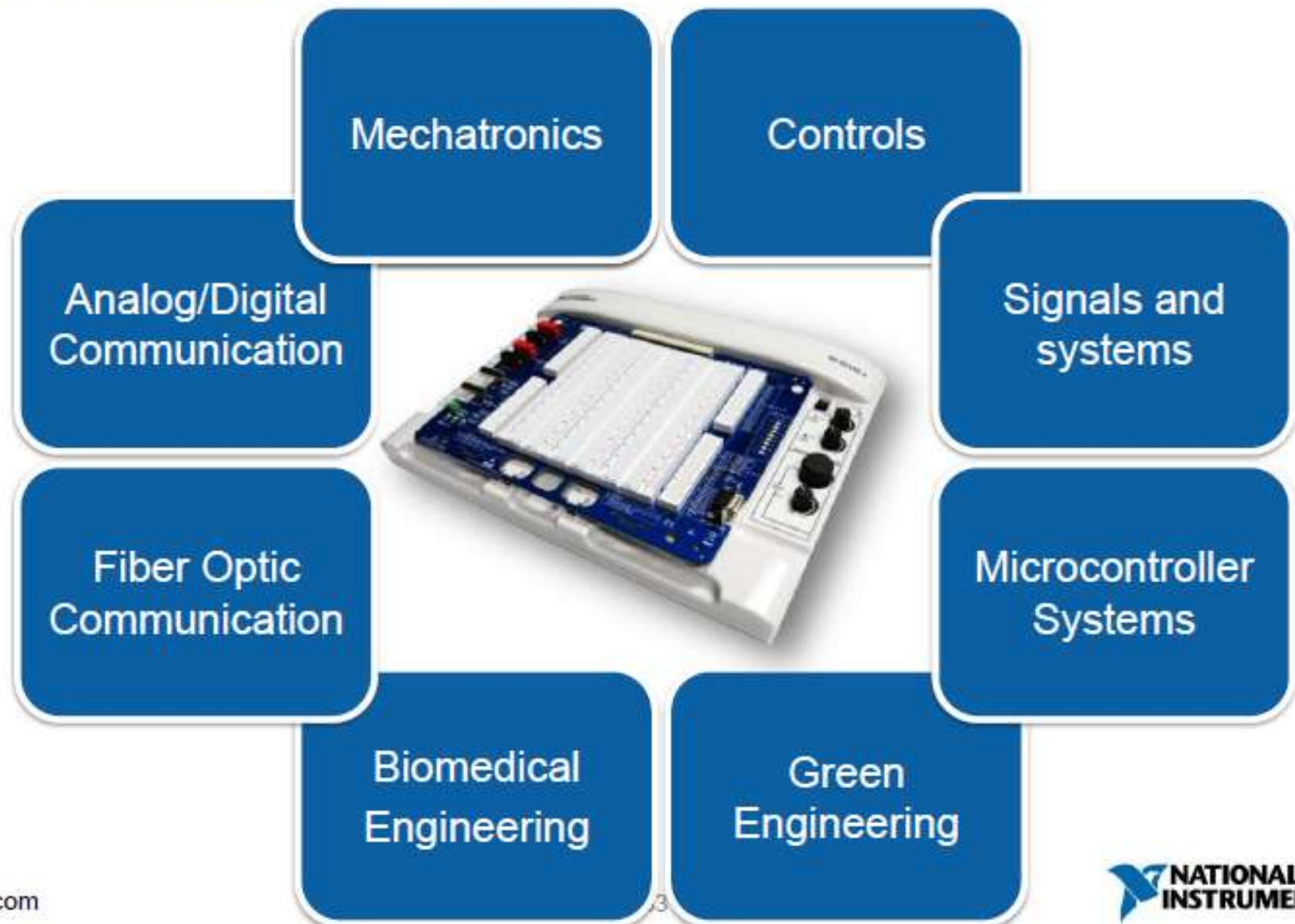
Academic: NI ELVIS



Industry: PXI

NI ELVIS Measurement & Instrumentation Platform

Circuits Teaching Hardware



NI ELVIS Measurement & Instrumentation Platform

Circuits Teaching Hardware



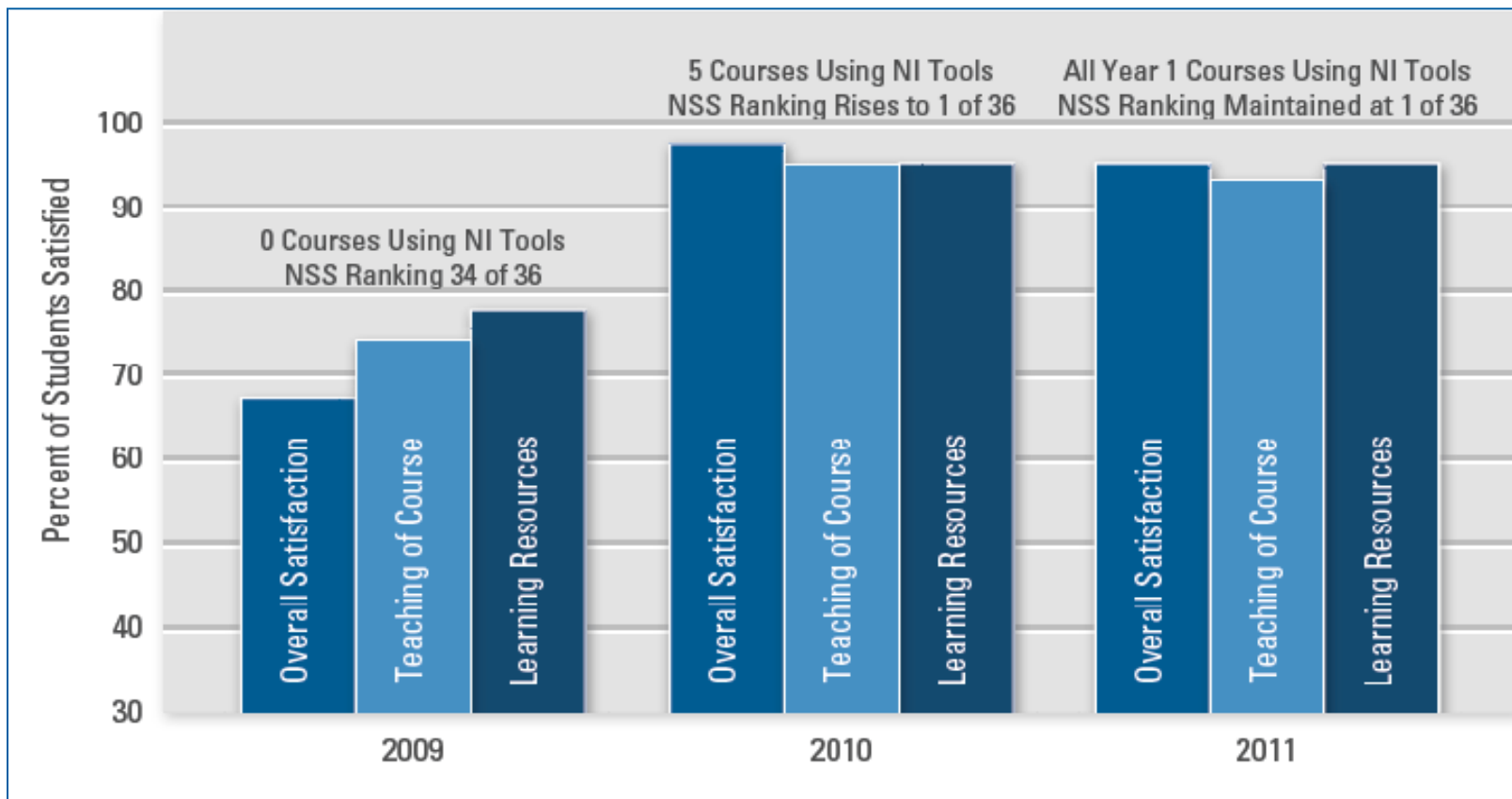


The University of Manchester



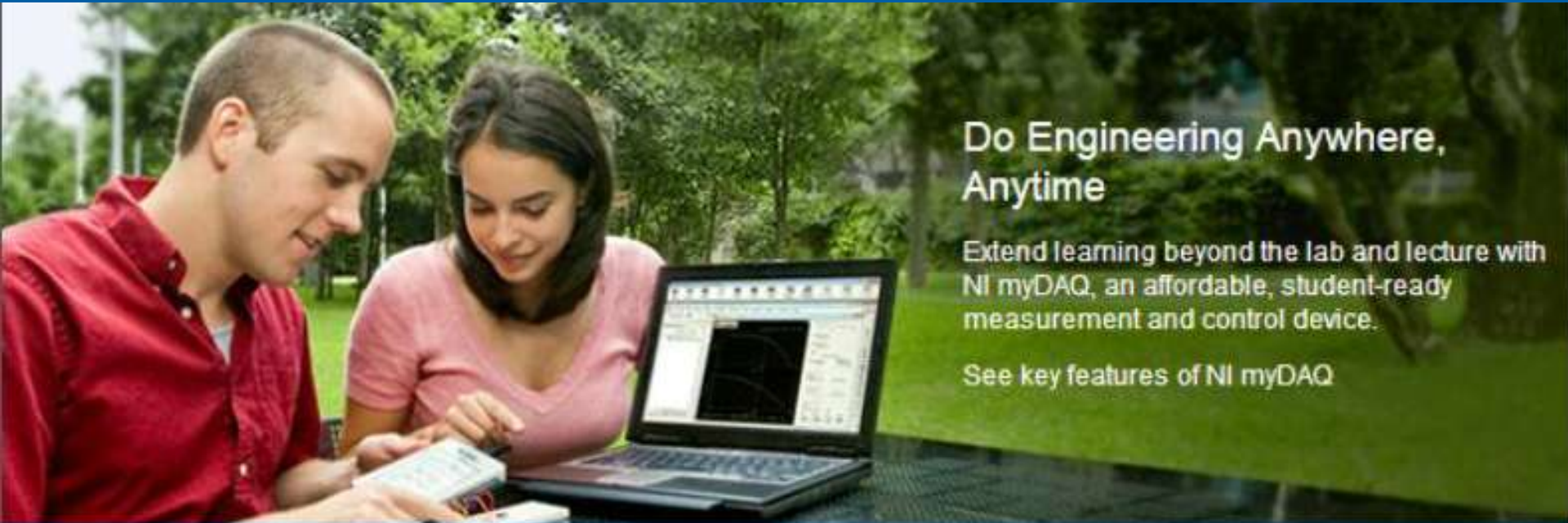
Teaching NI tools in our undergraduate courses is producing postgraduate research students who can deliver practical instrumentation, control, and communication solutions from day one. For them, the challenge is the research and not the tools that are needed to deliver it

- Peter Green, Senior Lecturer



The University of Manchester





Do Engineering Anywhere, Anytime

Extend learning beyond the lab and lecture with NI myDAQ, an affordable, student-ready measurement and control device.

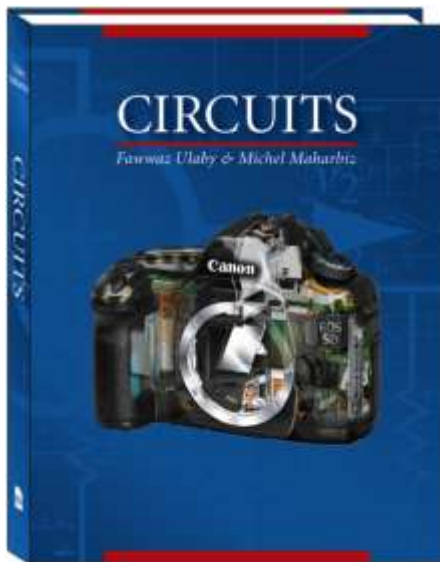
See key features of NI myDAQ

myDAQ Personal Instrumentation Platform

- Portable, cost-effective measurement and instrumentation platform
- USB connection to 8 instruments based on NI ELVIS
- Measure and visualize circuit data (as well other measurements)
- Engineering now possible anywhere (and everywhere)

Vision: Portable Lab for Independent Learning

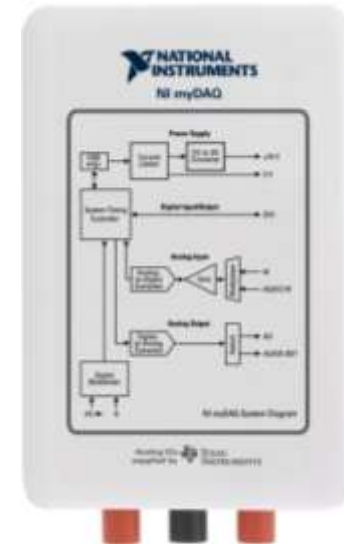
Delivering a complete solution for student owned hands-on learning



Textbook & Curriculum



Application Software



NI myDAQ

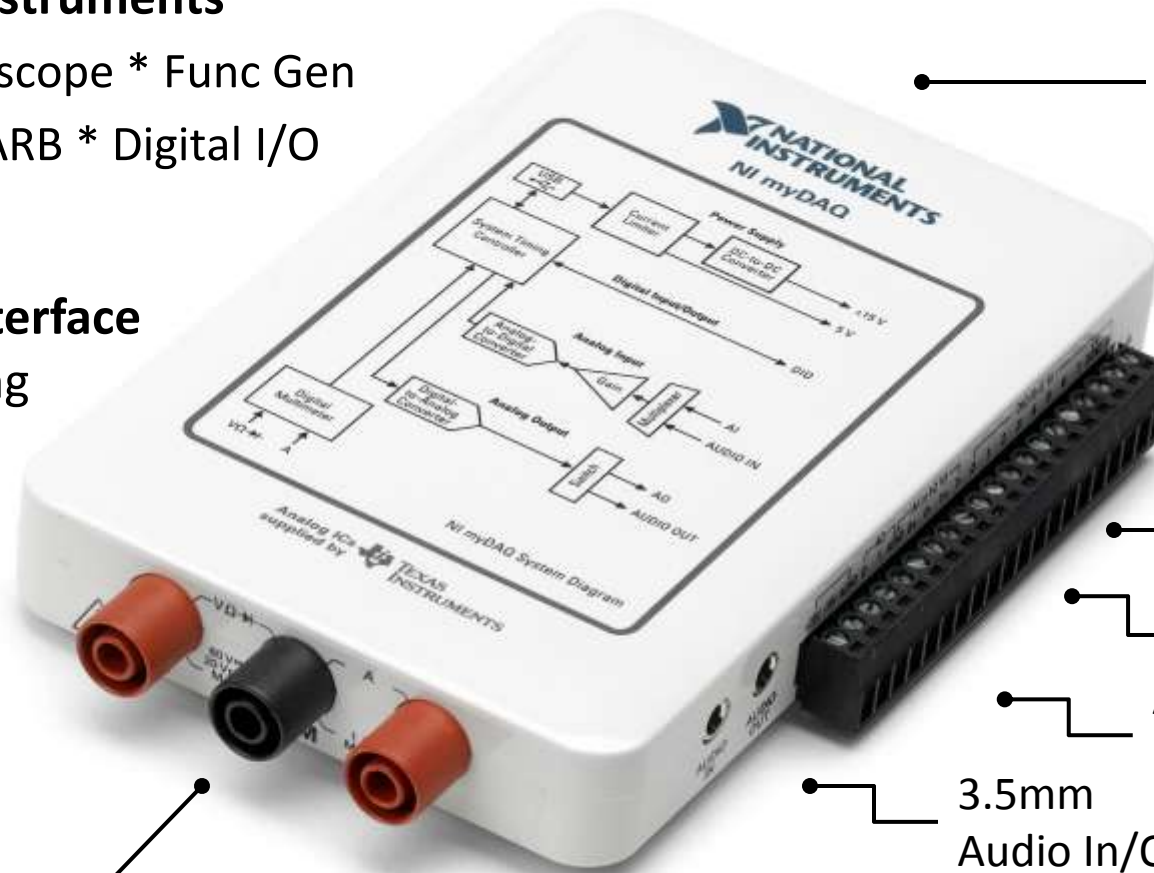
NI myDAQ Features

Plug & Play Instruments

DMM * Oscilloscope * Func Gen
Bode * DSA * ARB * Digital I/O

Computer Interface

LabVIEW using
NI DAQmx



USB Bus Powered

± 15 V and 5V
Power Supply

8 Digital In/Out

1 Counter

Analog In/Out
2 ch, 200ks/s

3.5mm
Audio In/Out

Integrated DMM
V, I, Ω , Diode

NI myDAQ Features

Plug & Play Instruments

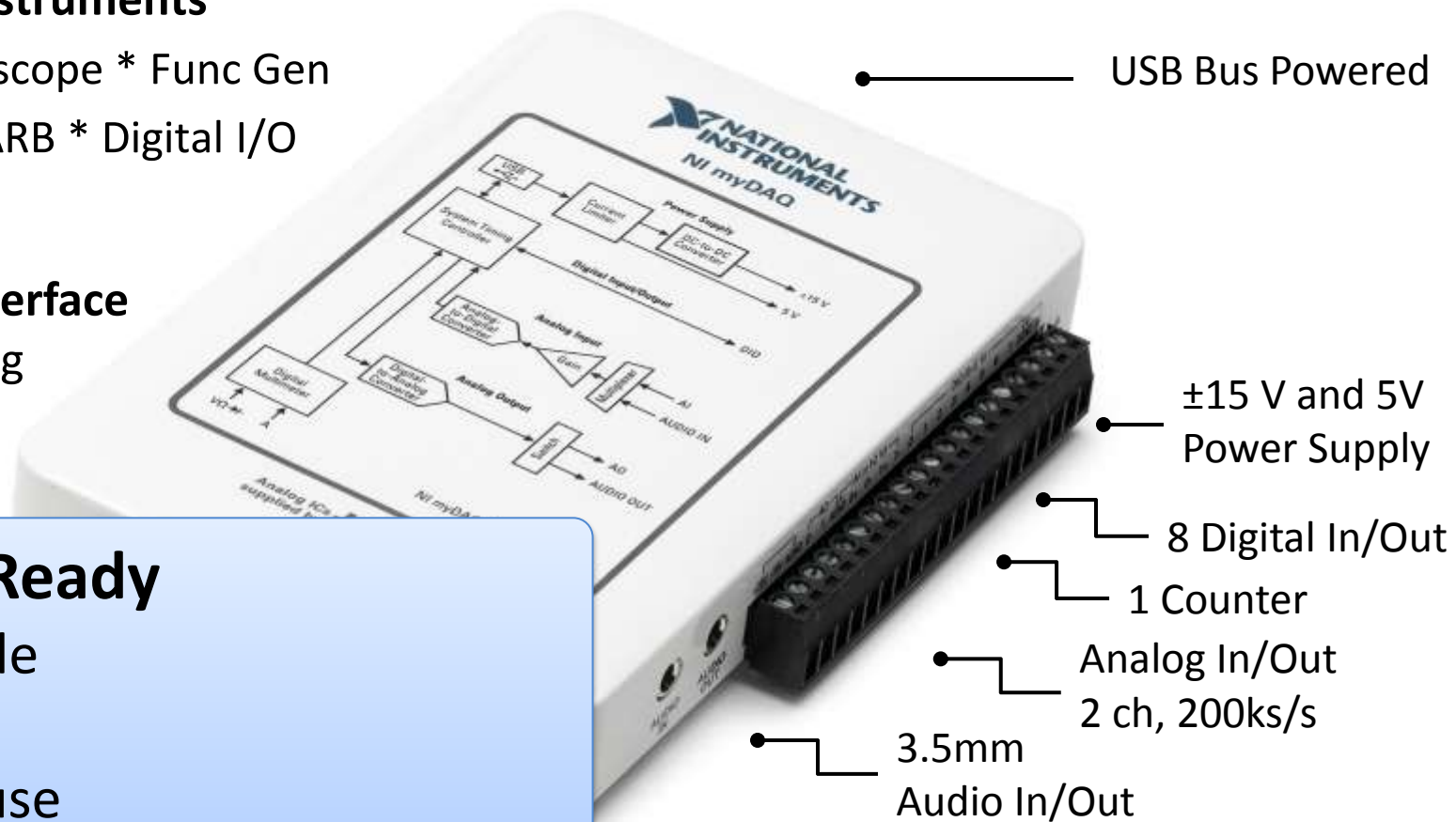
DMM * Oscilloscope * Func Gen
Bode * DSA * ARB * Digital I/O

Computer Interface

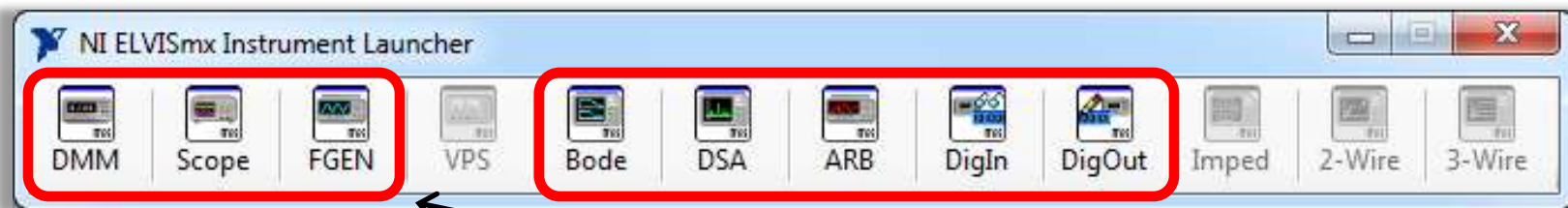
LabVIEW using
NI DAQmx

Student Ready

- Affordable
- Rugged
- Easy-to-use
- Small form factor
- Useful throughout curriculum

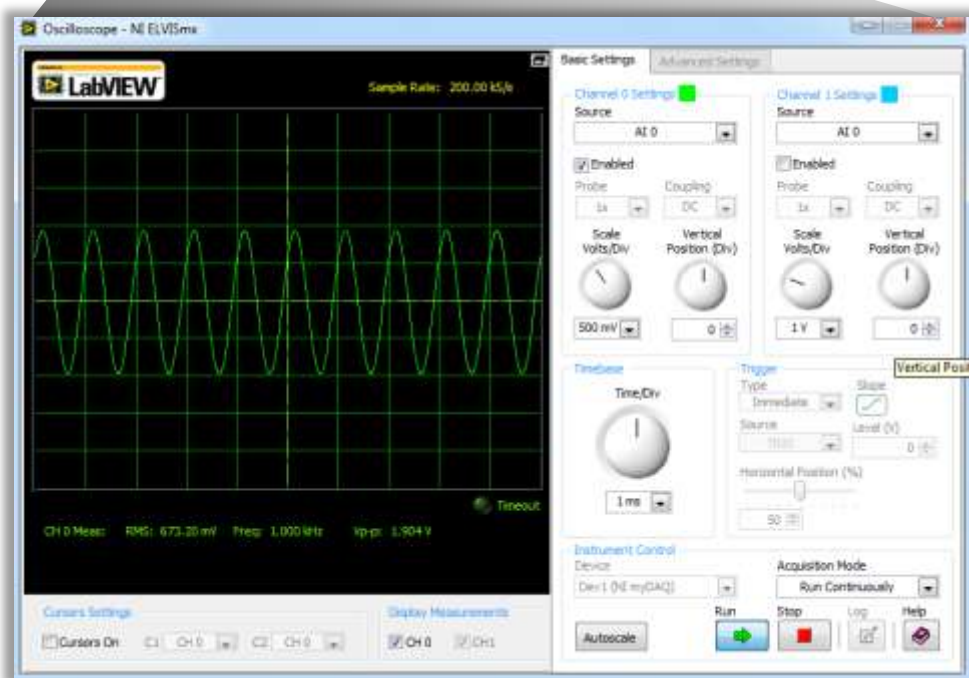


NI ELVISmx Instruments for myDAQ



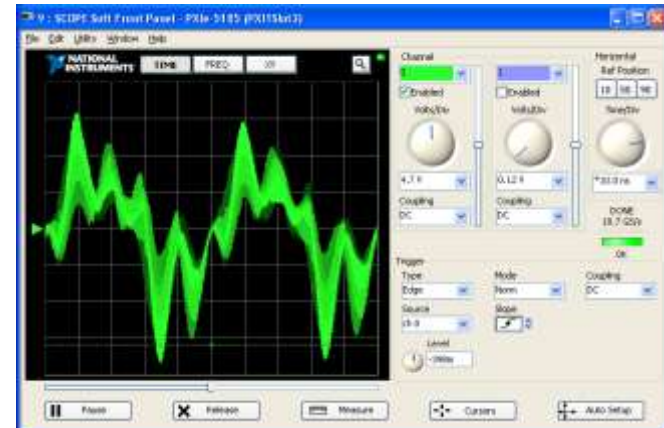
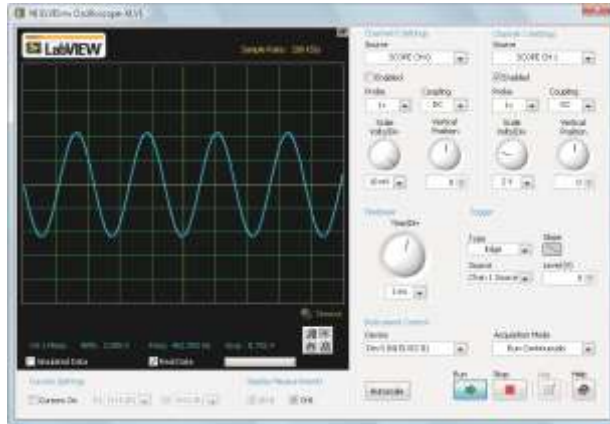
Supported Instruments

- DMM
- Oscilloscope
- Function Generator
- Bode Analyzer
- Dynamic Signal Analyzer
- Arbitrary Waveform Generator
- Digital Reader
- Digital Writer



Begin Taking Measurements

Soft Front Panels



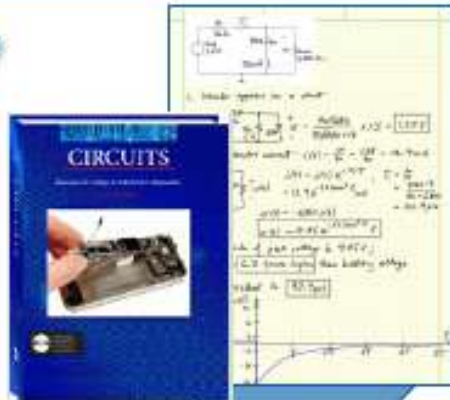
Academic: NI myDAQ



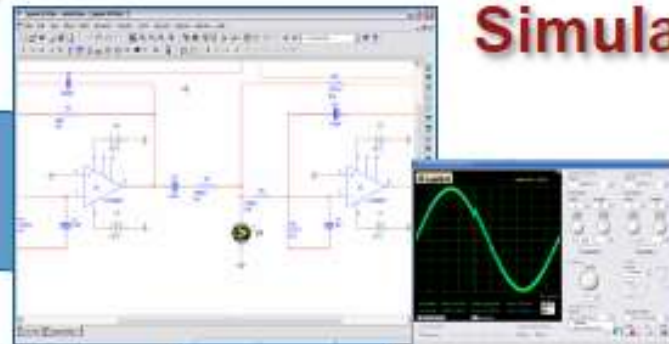
Industry: PXI

Using the NI Circuits Solution

Theory



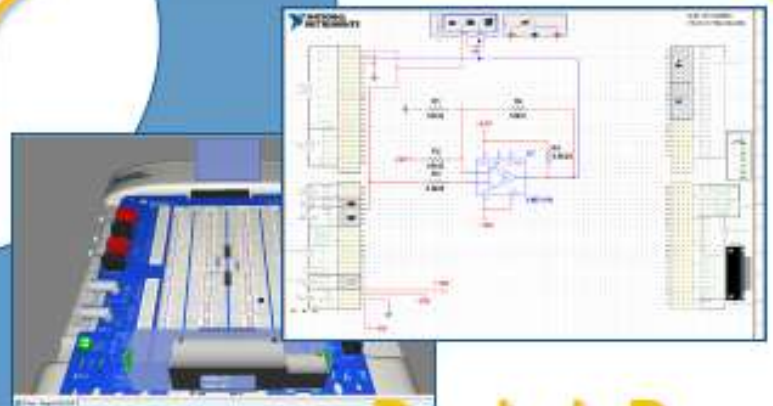
Simulate

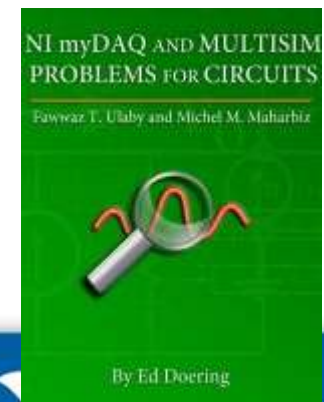
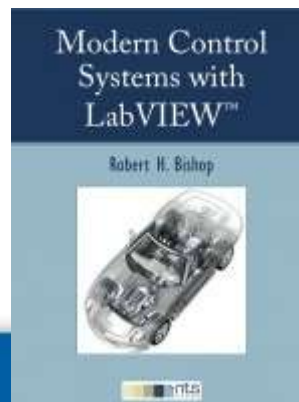
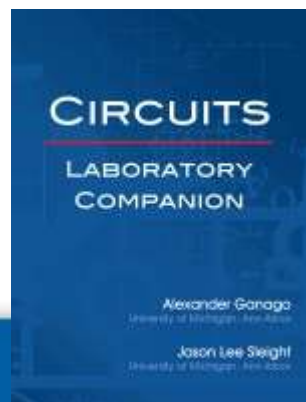
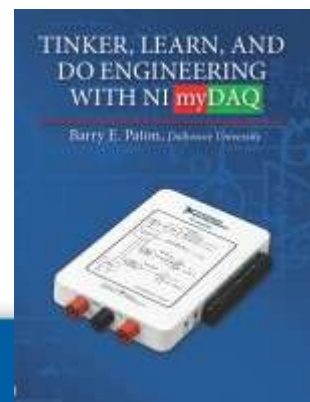
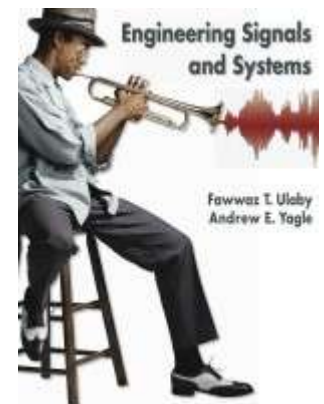
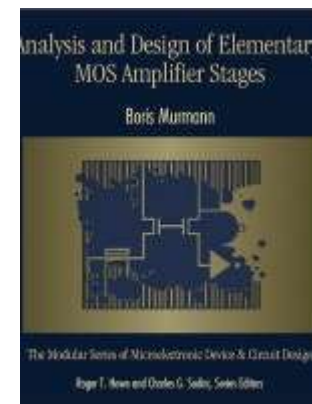
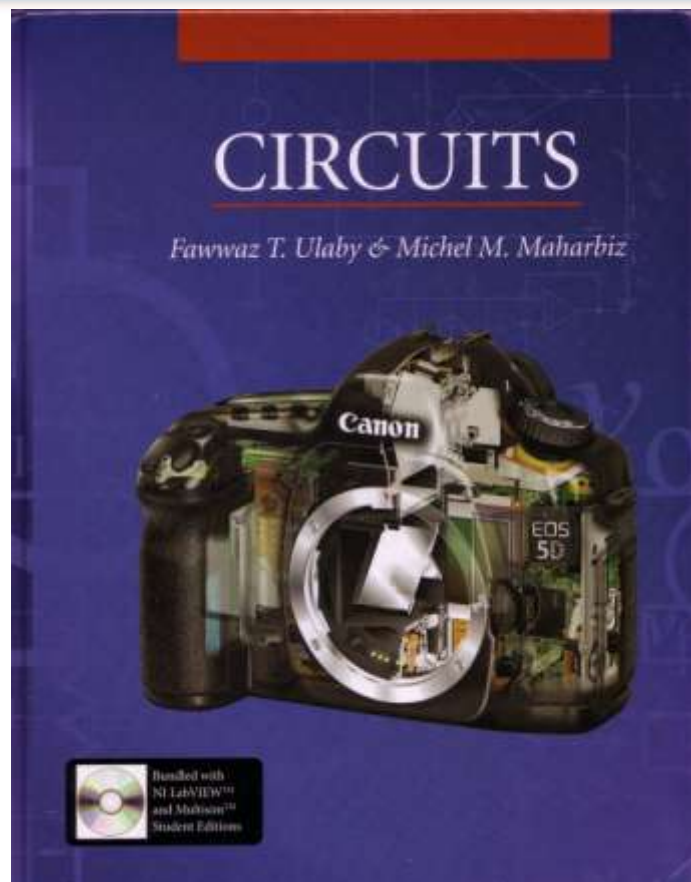


Laboratory



Pre-Lab Prep





Demo NI Electronics Educational Platform



NI ACADEMIC

National Instruments gives educators the tools to make it possible for students to do engineering.

Go to: [NI.com/Academic](https://ni.com/academic)

Educators



Learn how to incorporate NI LabVIEW in your classroom and laboratory for teaching.

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Researchers



Explore how to use LabVIEW in scientific computing and experimental research applications.

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Students



Discover how to use LabVIEW for your next class assignment and student design project.

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What's New

See the New NI myRIO

Check out the latest tool for student design and teaching controls, robotics, mechatronics, and embedded concepts.

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LabVIEW Video Instruction

Use this centralized e-learning experience to learn or teach LabVIEW in a modularized and digestible format

[Get started](#)

Evaluate NI myDAQ

Purchase the NI myDAQ Instructor Examination Unit to evaluate hardware, software, and courseware for your class

[See unit detail](#)

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[Circuit Design](#)

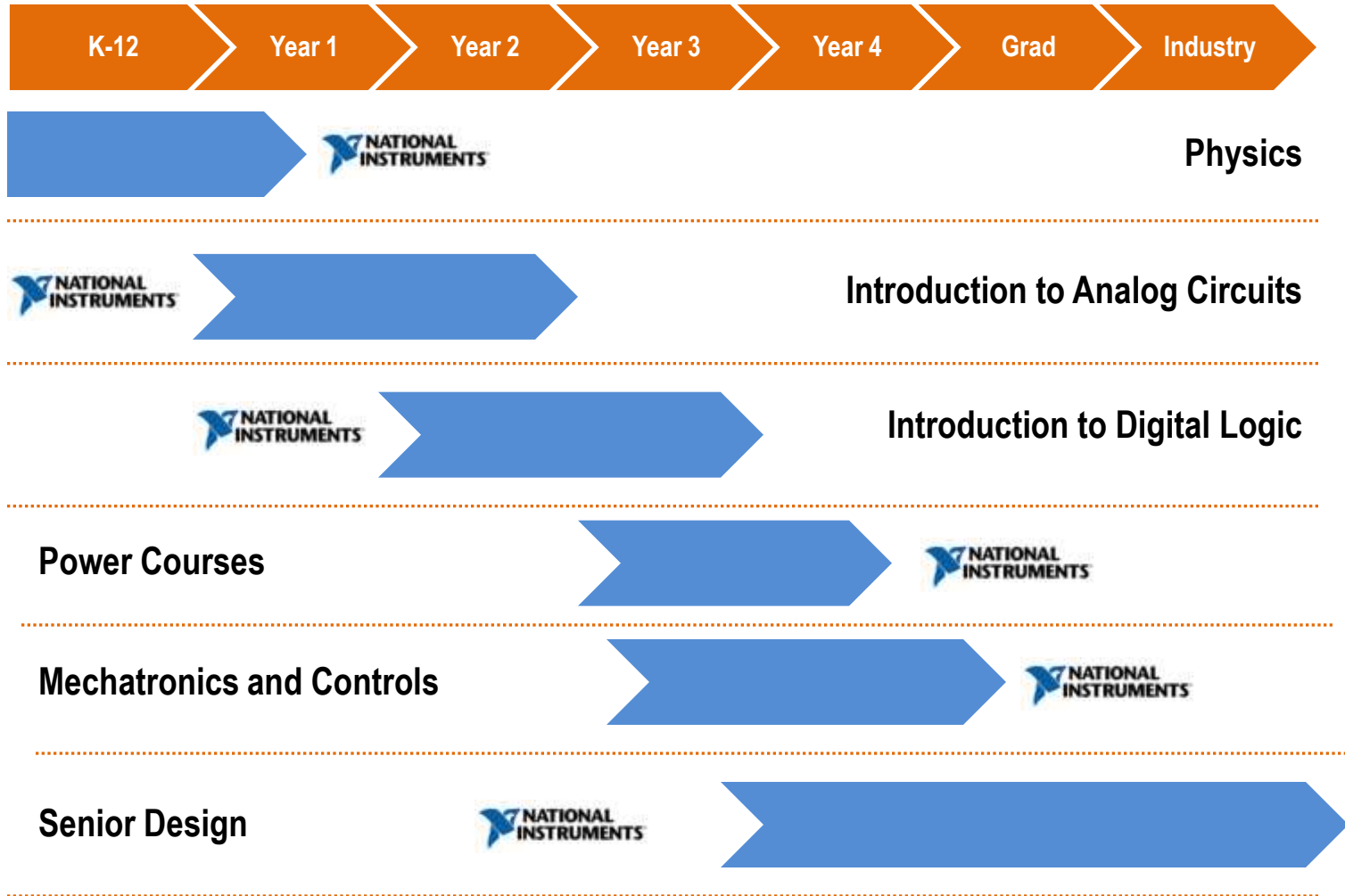
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National Instruments Circuits Solution





Do Engineering